

We claim:

1. A golf club head having a loft angle, comprising:

a hollow body having a crown, a sole, and a front striking plate located at the front of said hollow body;

said crown having a thickness of less than about 0.8 mm for at least a crown

5 transition distance of about 20 mm measured rearwardly from a junction of said crown and striking plate;

said sole having a thickness of less than about 1.0 mm for at least a sole

transition distance of about 20 mm measured rearwardly from a junction of said sole and striking plate; and

10 said striking plate having a thickness of less than about 2.2 mm, said

striking plate formed of a material having a hardness of at least 30 HRC and a percent elongation of at least 7%, said material having a density less than about 5 g/cc;

wherein said golf club head has a coefficient of restitution of at least about

0.85 if said loft angle exceeds 12 degrees and at least about 0.87 if said loft angle is 12 degrees or less.

15 2. The golf club head of claim 1, wherein:

said thickness of said crown is uniform and about 0.7 mm;

said thickness of said sole is about 0.9 mm; and

said thickness of said striking plate is centrally located on said striking plate

5 and has a maximum value of about 1.7 mm.

3. The golf club head of claim 1, wherein said striking plate comprises

beta-type titanium alloy.

4. The golf club head of claim 3, wherein said striking plate is formed of a titanium alloy comprising by weight about 4% aluminum, 20% vanadium, and 1% tin.

5. The golf club head of claim 3, wherein said striking plate is formed of a titanium alloy comprising by weight about 4% aluminum, 16% vanadium, and 6% chromium.

6. The golf club head of claim 3, wherein said striking plate is formed of a titanium alloy comprising by weight about 3% aluminum, 8% vanadium, 6% chromium, 4% molybdenum, and 4% zirconium.

7. The golf club head of claim 1, wherein said striking plate is formed of a titanium alloy comprising by weight about 4.5% aluminum, 2% molybdenum, and 3% vanadium.

8. The golf club head of claim 1, wherein said striking plate has a height of at least about 40 mm.

9. The golf club head of claim 1, wherein the striking plate's periphery has a thickness that is about 0.5 mm less than thickness at the striking plate's geometric center.

10. The golf club head of claim 1, and further comprising a weight member having a mass between 15 and 25 grams, such that the club head has a total mass between about 180 and 200 grams.

11. A metal golf club head, comprising:
- a body having a crown and a sole;
- a striking plate, said crown and said sole integrally cast to define a front opening and said striking plate being welded thereto;
- 5                   said crown having a substantially constant first thickness of about 0.7 mm, said sole having a substantially constant second thickness of about 0.9 mm, and said striking plate having a third thickness of about 1.7 mm, said third thickness of said striking plate being centrally located and about 0.5 mm thicker than a peripheral thickness of said striking plate that is located radially outward adjacent the weld joint at said front opening; and
- 10                  said striking plate formed of a titanium alloy substantially comprising by weight about 4% aluminum, 20% vanadium, and 1% tin;  
wherein said golf club head has a coefficient of restitution of at least about 0.89.
12. The metal golf club head of claim 11, wherein said sole has a weight member adding about 20 grams, such that the club head has a total mass of about 190 grams.
13. A method of manufacturing a golf club head having a loft angle comprising:
- forming a body having a crown, a skirt, and a sole defining a front opening;
- forming a striking plate of a material having a hardness of at least 30 HRC,
- 5                   a percent elongation of at least 7%, a density of less than about 5 g/cc, and a maximum thickness of less than about 2.2 mm, said crown having a thickness of less than about 0.8 mm over at least a crown transition distance of about 20 mm measured rearwardly from the front opening, said sole having a thickness of less than about 1.0 mm over at least a sole transition distance of about 20 mm measured rearwardly from the front opening; and

attaching said striking plate to said front opening of said body;  
wherein said golf club head has a coefficient of restitution of at least about 0.85 if said loft angle exceeds 12 degrees and at least about 0.87 if said loft angle is 12 degrees or less.

14. The method of claim 13, wherein said attaching of said striking plate comprises welding.

15. The method of claim 13, wherein said forming comprises cold forming constituting at least about 30% cold working of said striking plate.

16. The method of claim 13, and further comprising integrally forming a thickened plate on an interior surface of said sole, to add between 15 and 25 grams to the mass of said golf club head.

17. The method of claim 13, and further comprising attaching a weight member to an interior surface of said sole, to add between 15 and 25 grams to the mass of said golf club head.

18. A method of manufacturing a golf club head, comprising the steps of:  
casting a body of a titanium alloy, said body having a crown, a skirt, and a sole defining a front opening, said crown having a thickness of about 0.7 mm, said sole having a thickness of about 0.9 mm;

5 providing a weight member of between 18 to 22 grams to said sole of said body;

cold forming a striking plate of a beta-type titanium alloy to have a hardness of at least 30 HRC and a percent elongation of at least 7%, said striking plate having a thickness of between 1.1 and 1.8 mm; and

- 10                    welding said striking plate to said front opening of said body;  
wherein said golf club head has a coefficient of restitution of at least 0.88.

19. The method of claim 18, wherein said striking plate is formed of a titanium alloy substantially comprising by weight about 4% aluminum, 20% vanadium, and 1% tin.

20. The method of claim 18, wherein said cold forming comprises at least 30% cold working of said striking plate.

21. The method of claim 20, wherein said cold forming is performed to create a peripheral thickness of said striking plate that is about 0.5 mm less than a thickness at a center of said striking plate

22. A metal golf club head, comprising:  
an integrally cast body having a crown and a sole that define a front opening;

5                    a striking plate welded to the front opening of the cast body;

said crown having a substantially constant first thickness of about 0.7 mm, said sole having a substantially constant second thickness of about 0.9 mm, and said striking plate having a third thickness of about 1.7 mm; and

10                    said striking plate formed of a titanium alloy substantially comprising by weight about 4.5% aluminum, 2% molybdenum, and 3% vanadium;  
wherein said golf club head has a coefficient of restitution of at least 0.88.

23. A method of manufacturing a golf club head, comprising:  
casting a body of a titanium alloy, said body having a crown, a skirt, and a sole defining a front opening, said crown having a thickness of about 0.7 mm and said sole having a thickness of about 0.9 mm;

5 providing a weight member of between 18 to 22 grams to said sole of said body;

cold forming a striking plate of an alpha-beta-type titanium alloy to have a hardness of at least 30 HRC, a percent elongation of at least 7%, and a thickness of about 1.7 mm; and

10 welding said striking plate to said front opening of said body;  
wherein said golf club head has a coefficient of restitution of at least 0.88.

24. A golf club head having a loft angle, comprising:

a hollow body having a crown and a sole, said crown having a substantially uniform thickness of less than about 0.8 mm, and said sole having a thickness of less than about 1.0 mm; and

5 a striking plate provided at a front of said body and having a thickness of less than about 2.2 mm at a central portion, said striking plate formed of a material having a hardness of at least 30 HRC, a percent elongation of at least 7%, and a density less than about 5 g/cc, said striking plate having an upper portion forming an obtuse angle with said central portion of said striking plate and a lower portion forming an acute angle with said central portion;

10 wherein said golf club head has a coefficient of restitution of at least about 0.85 if said loft angle exceeds 12 degrees and at least about 0.87 if said loft angle is 12 degrees or less.

25. The golf club head of claim 24, wherein said body comprises a toe and said striking plate has a toe portion wrapping rearward for mating with said toe.

26. The golf club head of claim 15, wherein said body further comprises a heel and said striking plate has a heel portion wrapping rearward for mating with said heel.

27. The golf club head of claim 24, wherein said upper portion and said lower portion each include a thickness of less than about 2.2 mm.

28. The golf club head of claim 24, wherein said striking plate is cold formed.

29. The golf club head of claim 24, wherein said striking plate is hot forged.